



SINGER
INSTRUMENTATION

MICROWAVE LEVELER

700 SERIES

Serial No. _____

BAYTRON SYSTEMS CORP.
1720 Newport Circle
Santa Ana, Calif. 92705



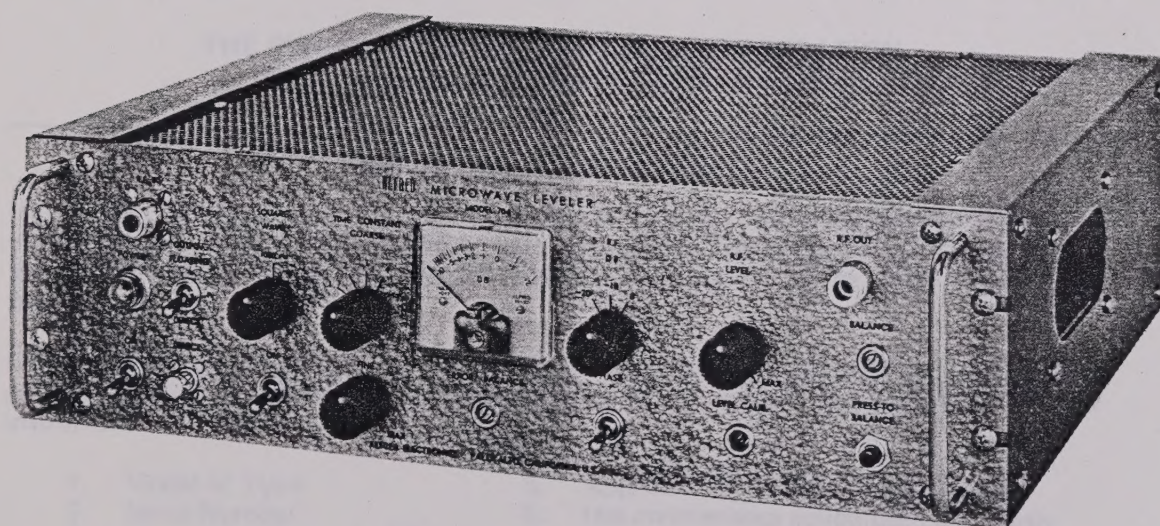
WARRANTY

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1720 Newport Circle
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THE SINGER COMPANY, LOS ANGELES OPERATION
5340 Alla Road, Los Angeles, California 90066

CALIF.

WARRANTY

THE SINGER COMPANY, LOS ANGELES OPERATION, (SELLER) warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

TCXO Oscillator 2 Years
Electrical and Electronic Measuring Instruments..... 1 Year

Repair or replacement (at our option) without charge (F.O B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and RatioTran potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other warranties, express or implied INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, or fitness for a particular purpose. In no event shall the SELLER be liable for INCIDENTAL OR CONSEQUENTIAL damages. The SELLER neither assumes, nor authorizes any person to assume for it, any other liability in connection with sales of instruments manufactured by SELLER.

With respect to repairs, the foregoing warranty shall apply for a period of ninety days to the repaired portion.

THE SINGER COMPANY, LOS ANGELES OPERATION
5340 Alla Road, Los Angeles, California 90066

REPAIR AND MAINTENANCE

Instruments should be returned only on prior authorization from the Singer Representative or the factory. You will be advised of detailed shipping instructions at that time. Return the instrument to the factory Prepaid. Validity of warranty will be determined by the factory.

Chargeable repairs: If requested, an estimate of charges will be made prior to repairs. Please provide us with the following information in order to expedite the processing of your instrument:

- | | |
|---|--|
| 1. Model or Type | 5. Approximate number of hours in use. |
| 2. Serial Number | 6. Has maintenance action been previously requested. |
| 3. Description of trouble(1) | 7. Other comments. |
| 4. Approximate date instrument was placed in operation. | |

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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MICROWAVE LEVELERS MODEL 704 AND UP

SPECIFICATIONS

<u>Model</u>	<u>Frequency Range Gc</u>	<u>RF Connectors</u>
705	1 to 4	Type N
704	4 to 8	Type N
706	8.2 to 12.4	X Band Flange
708	7 to 11	Type N
RF Power:	100 mw maximum.* Average power indicated on 2" panel meter with 12 db range. 0 db meter indication may be set at 0 to -20 db of maximum power rating.	
RF Control Range:	+2 to -30 db relative to maximum level, adjustable by panel switch and vernier control.	
RF Output Variation:	± 1 db over frequency range. Typically ± .1 db with 30 db input change at fixed frequency, when controlling a device with sensitivity of .5 db/volt or greater.	
RF Insertion Loss:	Less than 1.5 db.	
Control Output Voltage:	Direct: 0 to 100 volts from -50 to +100 volt range, 0 to 5 ma. Panel BNC receptacle. Floating: 0 to 450 volts, 5000 volts insulation to chassis, 0 to 3 ma. Rear terminals. Phase: Reversible with panel switch.	
Frequency Response:	Direct: DC to 100 kc maximum. Floating: DC to 50 kc maximum. Bandwidth selected by panel time constant switch and vernier control, from nominally 1 cps to maximum.	
Modulation:	Either CW or internal 800 to 1200 cps square wave.	

*Standard Levelers operate up to 100 mw maximum power level. On special order, units for leveling up to 1 watt are available in all bands. One watt units have the suffix -1 added to the model number, i.e., 705-1.

Power Input: 105 to 125 volts, 60 cps, approximately 250 VA

Physical: Bench mounting with perforated metal dust cover.
Handle sides removable for rack mounting.
Height: 5 1/4"
Width: 19"
Depth: 14 1/2" from panel, 15" overall

Finish: Panel, grey hammertone.
Sides, top; dark metallic grey.

Weight: Approximately 35 pounds.

SECTION 1 - GENERAL

1-1 DESCRIPTION

The ALFRED Microwave Leveler is a versatile, compact instrument which samples an RF signal, compares it with a reference voltage and provides as output the amplified error. To regulate the RF signal level, the output error voltage may be applied to any appropriate device capable of proportionally controlling its RF power output. Error voltage is available either relative to ground potential or fully isolated for connection to control electrodes operating at DC potentials up to 5 kv. The instrument, therefore, is particularly applicable for automatic suppression of RF output variations from Klystron Oscillator, Klystron Amplifier, Backward Wave Oscillator, and Traveling Wave Amplifier tubes.

Except for Model 700, a directional coupler and crystal detector are provided in the instrument for sampling RF power. These are broadband components so power may be held essentially constant over a wide frequency range. Model 700 contains the amplifier portion only so it may be used with external RF components. Direct coupled amplification in all models permits "leveling" of CW signals. Extremely high amplifier gain results in suppression of a 30 db power variation to .1 db when used with devices having control sensitivity of .5 db/volt or greater. Chopper stabilized amplification and well regulated reference voltage achieves low drift, constant RF output over long periods of time.

RF power level may be varied over a range greater than 30 db with panel voltage control unless restricted by the dynamic range of the controlled device. A panel meter indicates RF power level; its range is simultaneously varied with RF level switch. The Leveler thus can perform the function of a wide band, calibrated variable attenuator.

Amplifier bandwidth can be DC to a maximum value set by panel time constant controls from approximately 1 cps to 100 kc. This permits adjustment for optimum closed loop stability with fastest response. The use of a wide band amplifier and crystal detector permits suppression of rapid variations from BWO tubes electronically swept at high speed. Alternately, less bandwidth may be selected to control only average level of modulated RF signals.

An internal square wave generator is available to alternately turn OFF and ON the reference voltage and hence RF at 800 to 1200 cps. Square wave modulated RF therefore is available for external instrumentation or for optimizing the leveler transient response with time constant controls.

Model 700 Series Leveler is built as a convenient laboratory bench instrument. However, by removal of sheetmetal handle sides, it may be inserted in standard rack.

SECTION 2 - THEORY OF OPERATION

2-1 GENERAL

In this manual reference to panel control function is made with capital letters and

underlined, reference to chassis controls is made with capital letters only. Refer to block diagram of the Model 700 Series Leveler in Figure 2-1 and the schematic at rear of the manual. The instrument consists essentially of a directional coupler, crystal detector, DC chopper stabilized pre-amplifier, an adjustable reference voltage, a summing network, a 90° phase lag network, a low drift DC error amplifier and an oscillator-demodulator. Also included is a square wave generator which can modulate the reference voltage and thus the RF signal.

RF power is sampled by the directional coupler and converted to a voltage by the crystal detector. The pre-amplifier raises detector voltage sufficiently to operate a panel power level meter. Voltage gain is adjustable from 2 to 1000 so zero db meter indication can represent a wide range of power levels. The difference between pre-amplifier output and reference voltage is obtained from a resistor summing network. It is then fed through a RC low-pass network. Both the R and C may be varied over a wide range. The frequency response of the RC network is less than either the pre-amplifier or the error amplifier which follows the network. It therefore determines the overall phase-frequency characteristic of the Leveler and hence the stability of a closed loop arrangement involving the Leveler as the feedback element.

The error amplifier is a wide band stable DC amplifier with a nominal gain of 500. Phase of the error signal may be reversed by a panel switch. Amplified error output is available on the panel DIRECT output connector for supplying control voltages relative to chassis ground. To obtain control voltage insulated from chassis, the error output can be selected to amplitude modulate a 5 mc power oscillator which drives a demodulator through an isolation transformer. DC insulation up to 5 kv is provided by the isolation transformer. The high carrier frequency permits demodulator response of DC to approximately 50 kc.

A panel switch selects either DC or square wave modulated reference voltage to the resistor summing network. The square wave generator when used, alternately reduces reference voltage to zero. RF voltage matches reference and is thereby modulated.

2-2 CRYSTAL DETECTOR

On all standard ALFRED Microwave Levelers except Model 700, the directional coupler and crystal detector are furnished as part of the instrument and are designed to have transfer characteristics constant within ± 1 db over the bandwidth of the instrument.

The coupler, or coupler plus a fixed attenuator, is used to drop the maximum power input to the crystal detector to 10 mw maximum on all instruments. Thus a 10 db coupler is used on the 100 mw instruments, a 20 db coupler on the 1 watt instruments, and either a 20 db coupler plus a 10 db pad or a 30 db coupler on the 10 watt models.

Since the crystal detector output will not follow a square law characteristic above a 1 mw output, a typical calibration chart with db corrections for power meter readings corresponding to 1 mw to 10 mw range is provided.

A crystal type RF detector is used because a fast response is necessary in order to provide high speed corrections.

2-3 PRE-AMPLIFIER

The pre-amplifier is a high gain DC feedback amplifier with chopper stabilization. Referring to the schematic diagram, the pre-amplifier consists of V1 through V6. Pentodes V1 and V2 comprise a differential amplifier feeding the cathode and grid of V5. Imbalance in V1 and V2 plate voltages may be corrected with R3. Cathode follower V4A is used to drive the low impedance cathode of V5. The amplified difference at the plate of V5 is fed to cathode follower V4B. Output signal from V4B is opposite in phase to the input signal and is shifted in DC potential by regulator tube V6 so that it is relative to chassis ground. A portion of the output voltage is sampled by LEVEL CALIB. potentiometer R24 and resistor R25 and fed back to the grid of V1 through R23. Input voltage is applied through R2. Because of the high gain of V1, V2 and V5, the output voltage at V6, Pin 2, automatically adjusts itself so the currents in R23 and R2 cancel each other.

The grid of V1 therefore remains at the same voltage as the grid of V2, that is, essentially ground potential. Since the gain is controlled by the amount of feedback used, the output voltage for any given input is dependent upon the setting of LEVEL CALIB. potentiometer R24. C1 bypasses R2 to provide phase lead for improved stability of a closed loop with the Leveler in the feedback path.

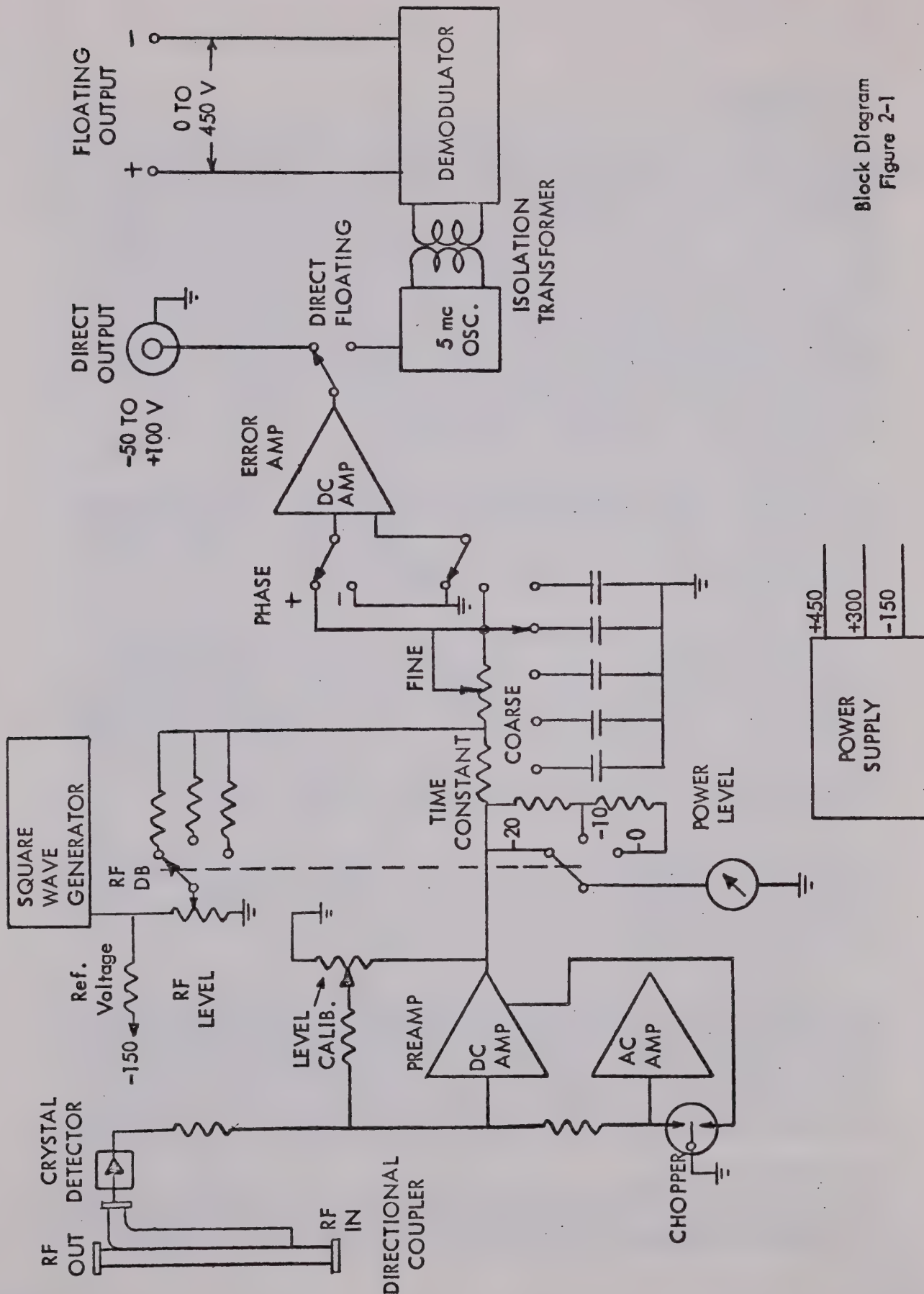
Should V1 grid differ from ground potential, the voltage is alternately shorted to ground through R9 by chopper RY2. This produces a rectangular voltage waveshape which can be amplified by AC amplifier V3 and rectified back to DC by the other chopper contact. After filtering through R12 and C2, the DC voltage is applied to the grid of V2. The chopper and V3 therefore constitute a driftless DC, carrier type high-gain amplifier, which samples error at V1 grid and applies amplified signal to V2 grid to correct for any offset at V1 grid. Response of stabilizing amplifier V3 is limited by filter R12 and C2 so that drift in the pre-amplifier is suppressed.

Depressing PRESS TO BALANCE switch SW2 shorts to ground, the drift correction signal at V2 grid. BALANCE control R3 then can be adjusted so pre-amplifier output has no unwanted DC component; that is, zero volts when input is zero. Error at V1 grid then is also zero so that upon release of SW2, chopper amplifier does not have to furnish any correction signal until drift from the balance point occurs.

Due to very small, but not negligible, grid current in V1 and V2 and thermal emf's in the chopper contacts, a small DC compensating voltage is introduced by R14, R15 and OFFSET potentiometer R79 in the chopper circuit. Incorrect or no compensation will cause non-zero meter indication just after balancing pre-amplifier when its gain is maximum and input zero. OFFSET potentiometer R79 has been factory set to provide best typical compensation, but may have to be adjusted slightly if V1 or V2 is replaced.

2-4 POWER METER

Pre-amplifier output at Pin 2 of V6 is connected to power level meter M1 through DB switch SW3A and voltage multiplying resistors R42 and R43. The crystal detector,



Block Diagram
Figure 2-1

because of its square law characteristic, produces a voltage essentially proportional to power. The voltage indication of M1, therefore, is proportional to RF power level. A 10:1 change in voltage sensitivity thus gives a 10 db change of power indication. Resistor R44 in series with M1 is added as required to correct meter resistance to a standard nominal value for use with R42 and R43 in range multiplication.

At power levels up to 10 db below rated maximum, the crystal detector gives reasonably accurate power indication. However, above this point deviation from square law response causes error in power meter indication. A typical calibration curve for correcting the readings at highest power levels is presented in Figure 2-2.

2-5 SUMMING NETWORK

Crystal detector voltage, which is negative, is inverted by the pre-amplifier to positive and fed to resistor R27. Negative reference voltage is fed through either R29, R30, or R31. The signal voltage adjusts itself so the IR drops in the resistors give approximately zero voltage at the summing junction. Any difference constitutes an error which is subsequently amplified. Change of resistance to the reference alters current and hence signal voltage required to maintain negligible error. In this manner, RF DB switch section SW3B selects RF power level for balance.

2-6 TIME CONSTANT NETWORK

The time constant network furnishes the necessary phase compensation for stability of the loop during sweep operation. R and C may be varied over a wide range in obtaining optimum frequency response. The frequency response of the time constant network is less than either the preceding pre-amplifier or the following error amplifier, so that it is the determining factor in establishing the overall phase-frequency characteristic.

Error voltage is connected through TIME CONSTANT FINE potentiometer R28 and PHASE switch SW4 to a grid of V7. Capacitor C9, C10, C11, C12 or C13 may be selected to bypass R28 for COARSE time constant adjustment. PHASE switch reverses signal connection to V7 grids to change sign of error amplifier output.

2-7 ERROR AMPLIFIER

The error amplifier consists of differential amplifier V7, cathode follower-amplifier V8, cathode follower V9 and voltage regulator tube V10. Tube functions are identical to the corresponding tubes in the pre-amplifier except triodes have been employed. A lower gain requirement permits this simplification. OUTPUT FLOATING - DIRECT switch SW6A connects amplified error to either DIRECT panel receptacle or to the screen grid of V11.

ERROR BALANCE potentiometer R32 provides a means of compensation for zero shift due to tube imbalance in the two halves of differential amplifier V7. For zero error input at grid of V7, the output at V10, Pin 7, can be made zero by changing the relative plate voltage to V7 with R32.

TYPICAL
HIGH R F LEVEL
POWER METER CALIBRATION

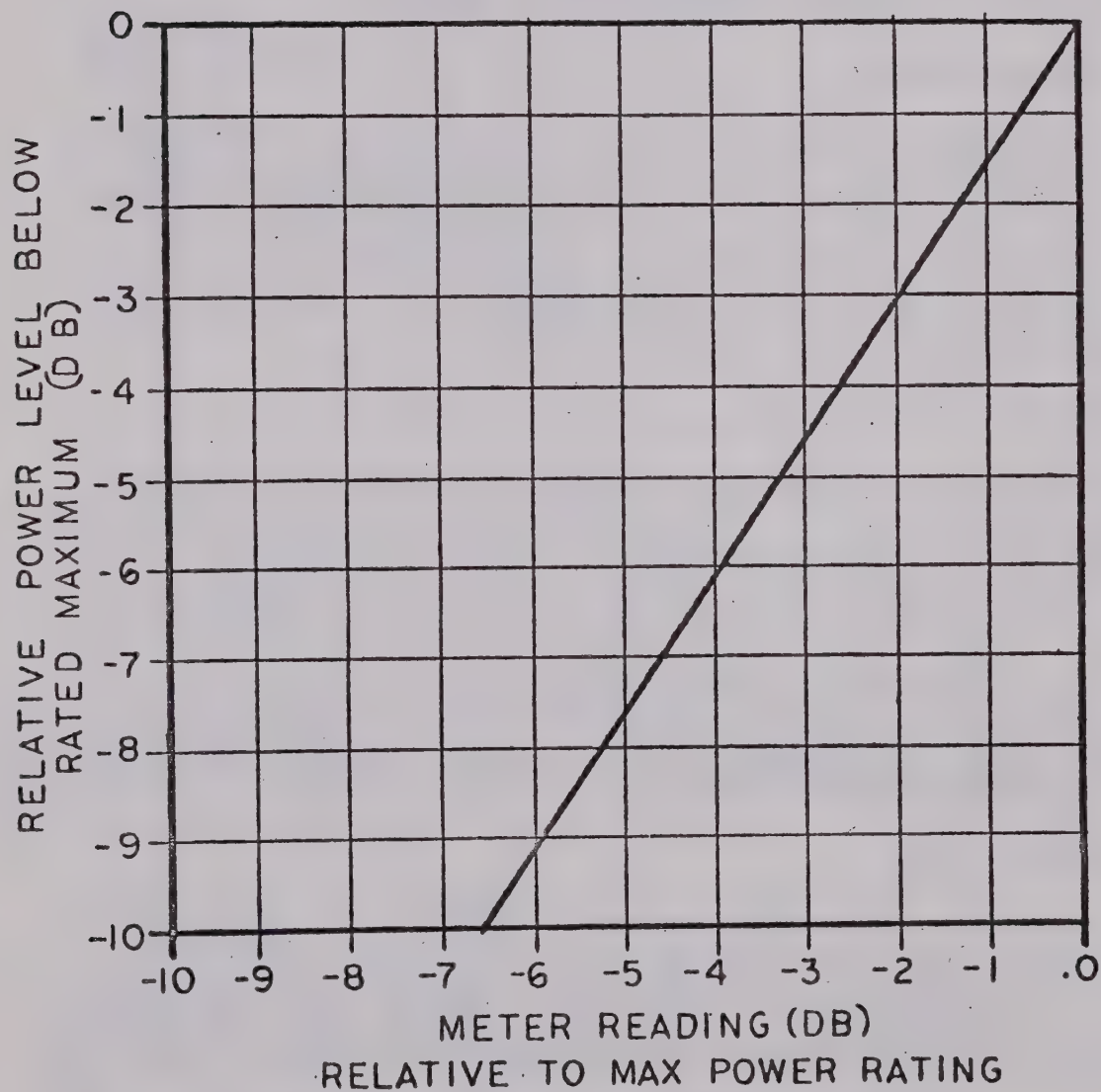


FIGURE 2-2

2-8 OSCILLATOR-DEMODULATOR

Floating output voltage of zero to 450 volts is obtained from the filtered output of voltage doubling rectifier V12. Power to V12 is supplied through isolating transformer T4 by power oscillator V11 which is screen grid modulated. Carrier frequency is approximately 5 mc permitting the filter to adequately reject carrier ripple and still have good control response. C16 and C21 resonate with L1 and L2 respectively at carrier frequency for maximum attenuation by the filter network. The floating output is intended for low current relatively high impedance electrodes. For best response, external circuit capacitance must be kept as low as possible.

2-9 SQUARE WAVE MODULATION

When SQ WAVE switch SW5 is in the ON position, a square wave modulation of the RF power is provided. Tube V13 is used as a multivibrator with a frequency range adjustable from 800 to 1200 cps. Frequency adjustment is accomplished by potentiometer R50. Increased positive volts increases the multivibrator frequency. The square wave output is taken from V13 plate, Pin 6, through capacitor C15 and connected to the grid, Pin 7, of cathode follower V14. The plate swing is sufficient to cause V14 right side to conduct sufficiently to raise its cathode voltage to several volts above zero. However, V14 left side, connected as a diode limiter clamps the cathode, Pin 8, to slightly above ground. Since the RF output follows the RF LEVEL potentiometer voltage, it is reduced to zero during the positive half cycle of the square wave at grid, Pin 7, of V14.

2-10 POWER SUPPLIES

Well regulated DC voltages of +300 and -150 volts are provided by the internal supplies. In addition, unregulated +450 volts is also furnished.

The -150 volt source consists of full wave rectifier connection of V19, V20, triode connected series regulator tubes V21, V22 in parallel, control amplifier tubes V23, V25 and reference tube V24. Differential amplifier V25 compares at its grids the reference voltage from V24 with a portion of supply output voltage at the junction of R76 and R78. The amplified difference at V25 plates is fed to the cathode and grid of V23 left half. The cathode is driven by the V23 right half connected as cathode follower. The further amplified difference at the plate of V23 left half is connected to grids of series tubes V21 and V22 to effect regulation. Several tube heaters and RY1 are operated from the -150 volt supply. Drift and noise from the tube heaters are thereby eliminated. RY1 does not operate to turn on V15, V16, V17 heaters until -150 volts is on. This assures DC supplies turn on in proper sequence and positive sources are turned off upon heater burn-out or loss of -150 volts.

The +300 volt supply employs V16 as full wave rectifier, V17 as series tube, and V18 as control amplifier. Output is sampled by R64 and R68 and compared with reference voltage from V24.

An additional +150 volts unregulated is provided by rectifier-filter V15, C28, which

is connected in series with +300 volts to give +450 volts relative to chassis. This furnishes operating potential to the screen of V17 and plate of V11.

2-11 POWER AND SWITCHING

All power to the instrument is made by POWER switch SW1 which connects line voltage to the primary winding of transformer T1 through fuse F1. Relay RY1, remains in de-energized position until -150 volt supply is up to value, at which time it energizes the +300 and +450 volt supplies.

SECTION 3 - INSTALLATION AND OPERATION

3-1 TRANSIT DAMAGE

Immediately upon receipt, carefully unpack and inspect the instrument for damage received from transit. Should any damage be found, follow procedure outlined on "Shipment Damage Claim" page at the end of this manual.

3-2 POWER INPUT

Primary power requirements are 105 to 125 volts, 60 cps, at approximately 185 volt-amperes. If operation at any other voltages or frequencies is contemplated, consult manufacturer.

The three-conductor power cable supplied with this instrument is terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturers' Association. The third contact is an offset round pin added to a standard two blade AC connector and grounds the instrument chassis when used with an appropriate receptacle. **CAUTION:** Do not circumvent this safety precaution by removing the pin or using the connector with a two contact receptacle without an appropriate adapter. The adapter terminates the third contact in a short lead, which when connected to the outlet mounting box, will ground the instrument chassis.

3-3 MOUNTING

Model 700 Series Levelers are supplied with grey sheet metal sides containing recessed handles. If the instrument is to be rack mounted, the four screws on each handle side near the corners and the two screws at the edge of the panel should be taken out and the sides removed. Unit is now ready for inserting into a rack. Supports should be provided in the rack to carry the weight of the instrument upon insertion or removal.

CAUTION: The ambient temperature in the rack near the instrument must be maintained at less than 135° F.

3-4 RF CONNECTIONS

On all models, except 700, RF input cable or waveguide should be attached to ap-

appropriate fitting on the instrument. On Model 700, connect output of external detector or to panel INPUT connector. Detector output voltage must be negative polarity for correct panel meter indication. Connect either direct or floating control output as required. Microwave tubes having cathode potential negative with respect to ground will require floating output connected in series with a control grid or anode and its normal DC supply. In most ALFRED Microwave Amplifiers without panel grid or anode connections, the anode lead to the traveling wave tube power socket should be removed from the terminal strip just behind the panel. The negative floating control voltage lead should be connected to the terminal strip, the positive to the anode. Connect panel grid or anode receptacle on ALFRED Microwave Amplifiers to DIRECT output connector on the leveler panel. Any amplifier grid impedance switch should be on 100 K position. DIRECT output can also be used with ALFRED Microwave Oscillators by connection to EXT ANODE or EXT MOD jack. Figure 3-1 illustrates the general case for inter-connection between units.

The RF source should not be capable of output power under any conditions greater than 10 db above Leveler rated maximum. If necessary, use an attenuator to reduce source power to Leveler. Excess power, if accidentally applied, can permanently damage crystal detector.

3-5 OPERATING CONTROLS

POWER This switch controls all primary power to the instrument. Adjacent panel lamp indicates when power is on.

RF LEVEL This control sets the reference voltage which in conjunction with RF DB switch determines the level of RF output the Leveler will maintain.

RF DB This switch attenuates the RF LEVEL reference, and thereby the RF input, in decade amounts. At the same time it decreases correspondingly the input resistance to meter M1.

TIME CONSTANT COARSE This switch provides for coarse adjustment of the loop time constant by selecting C in decade intervals from .001 to 1 mfd.

TIME CONSTANT FINE This control provides for fine adjustment of the loop time constant by varying R from 0 to 250 K with potentiometer R28.

SQUARE WAVE This control sets the frequencies of the internal square wave generator and covers the range of 800 to 1200 cps.

SQUARE WAVE ON This switch energizes the square wave generator circuit to provide square wave modulation of the RF output.

PHASE This switch selects the polarity of the leveler output control signal to the RF source.

OUTPUT FLOATING - DIRECT This switch selects whether the direct leveler output control voltage is relative to ground and available at panel jack DIRECT or is floating and available at RED and BLK terminals on rear of chassis deck.

PRESS TO BALANCE This switch in conjunction with screw driver panel adjustment BALANCE provides zero balance of the pre-amplifier.

ERROR BALANCE This screw driver panel adjustment provides zero balance of the error amplifier.

LEVEL CALIB. This screw driver panel adjustment, by controlling the gain of the pre-amplifier, sets the RF level for a given meter indication.

As a practical example of the effect of the LEVEL CALIB. potentiometer, suppose that when a zero db reading of M1 is obtained by adjustment of RF LEVEL the output to the power meter or load is too low. In this instance, assuming the source has ample power, the gain of the pre-amplifier is too high, requiring too low a value of RF input to balance the reference voltage. Thus LEVEL CALIB. potentiometer R24 must be turned CW to reduce the gain and thereby allow more RF power through the instrument. Conversely, if the power output had been too high for zero db indication, the pre-amplifier gain would be too low and LEVEL CALIB. potentiometer would have to be turned CCW to increase its gain.

As a second example, suppose that M1 reads low and cannot be made to read zero db with RF LEVEL control. In this case, the gain of the pre-amplifier is so low that saturation of the signal source occurs before zero db reading is obtained. Turn LEVEL CALIB. potentiometer CCW to increase the pre-amplifier gain and thereby increase the reading of M1.

3-6 INTERNAL ADJUSTMENTS

OFFSET This adjustment, located on the chassis, provides correction for any small emf's and grid currents in V1 and V2. Adjust for no deflection of meter from zero indication upon release of PRESS TO BALANCE switch after balancing.

3-7 PANEL CONNECTORS

RF IN RF power input to Leveler (all models except 700).

RF OUT RF power out from Leveler (all models except 700).

INPUT The input to the Leveler from the crystal detector is made at this jack. (Model 700 only)

DIRECT The leveler output control voltage is available at this jack.

3-8 HOOK-UP PROCEDURE

The following procedures are suggested for connecting the leveler to an associated controlled microwave tube. For standby operation it is good practice to either turn the leveler RF LEVEL down or controlled device high voltage off.

Case No. 1, Controlled Device - ALFRED Model 601-0 () Sweeping Oscillator

- a. Connection: DIRECT out on leveler to EXT ANODE on 601-0 ()
- b. Place phase switch to "-" position, since Model 601-0 () requires negative signal on EXT MOD input for increasing RF output.
- c. Remarks: The BWO tube can be overdriven by too large an external control signal. The helix overcurrent relay is the only protection for the BWO tube. Therefore extreme care should be exercised to prevent accidental excess control voltage which may seriously overcurrent the tube.

Case No. 2, Controlled Device - ALFRED Model 602 Sweeping Power Supply

- a. Connection: DIRECT out on leveler to EXT GRID on 602
- b. Place PHASE switch to "+" position, since Model 602 requires positive signal on EXT GRID for increasing RF output.
- c. Remarks: The Model 602 grid supply can only be driven in the negative direction and can never be driven positive regardless of input, hence the microwave tube is protected.

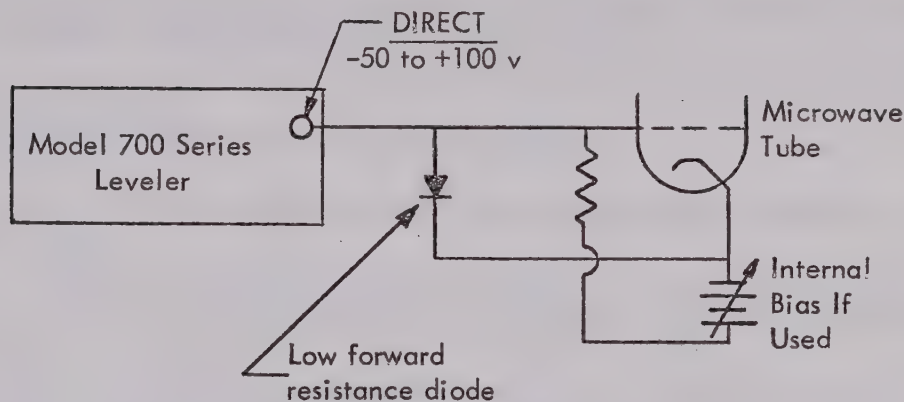
Case No. 3, Controlled Device - ALFRED Models 605, 620 Series, and 620B Series Sweeping Oscillators

- a. Connection: DIRECT out on leveler to EXT MOD on Model 605, 620 Series, or 620B Series.
- b. Place PHASE switch to "-" position, since these oscillators require negative input at EXT MOD for increasing RF output.
- c. Remarks: The BWO tube in the Model 605, 620, or 620B is protected by a limiter diode so that the grid can never be driven positive regardless of input.

Case No. 4, Controlled Device - Microwave tube control electrode

- A. Negative grid - Grid return at ground

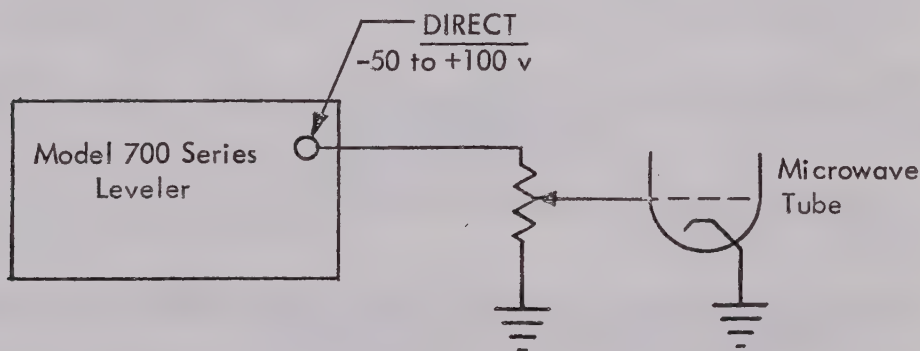
- a. Connection - see sketch below:



- b. Place PHASE switch to "+" position, since microwave tube requires positive going input to increase RF output.
- c. Remarks: Connect a shunt diode as shown to prevent the control input from causing positive grid operation.

- B. Positive grid - Grid return at ground - Normal grid voltage less than +100 volts.

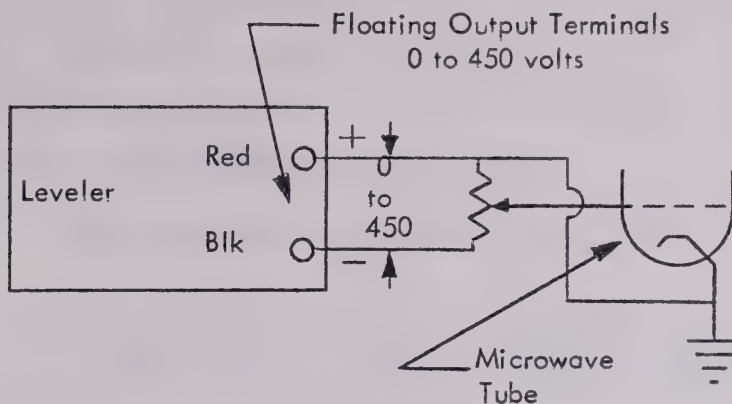
- a. Connection - see sketch below:



- b. Place PHASE switch to "+" position, since microwave device requires positive going signal for increased RF output.
- c. Remarks: The potentiometer is optional. It may be added to limit leveler output signal to safe grid value for microwave device.

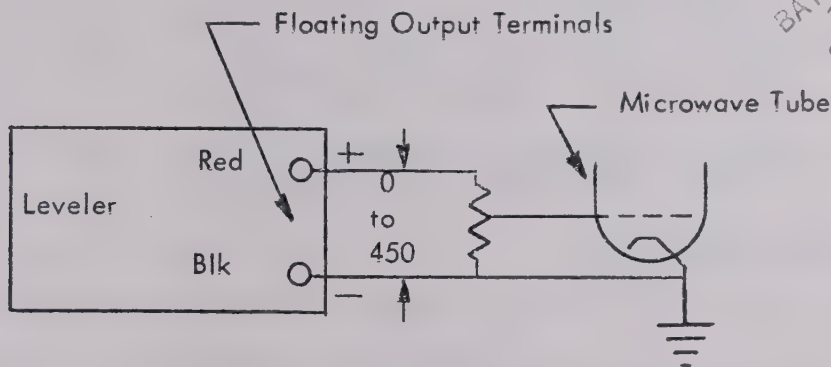
- C. Floating output - Negative control electrode - Electrode return either grounded or off ground.

- a. Connection - see sketch below:



- b. Place PHASE switch to "-" position, since microwave device cathode requires negative input relative to grid to increase RF level.
- c. Remarks: The potentiometer is optional. It may be used to limit maximum negative swing to prevent negative overvoltage of tube electrode.
- D. Floating output - Positive control electrode - Normal electrode voltage less than +450 volts - Electrode return either grounded or off ground.

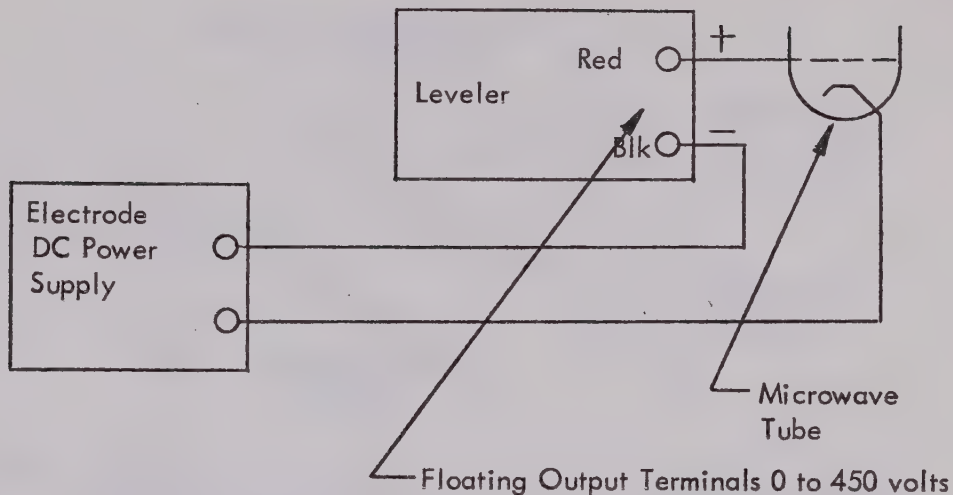
- a. Connection - see sketch below:



- b. Place PHASE switch to "+" position, since microwave device requires positive control electrode input for increased RF output.
- c. Remarks: The potentiometer is optional. It may be used to limit maximum positive swing to prevent overdriving of microwave tube
- E. Floating output - Positive control electrode - Normal electrode voltage greater than +450 volts - Electrode return either grounded or off ground.

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- a. Connection - see sketch below:



- b. Place PHASE switch to "+" position, since microwave tube requires positive going input to increase RF output.
- c. Remarks: Adjust the electrode power supply voltage so that when added to the maximum output signal (450 volts) from leveler, the total voltage to tube is the maximum operating value. When connected in this manner the leveler not only provides leveling but establishes the maximum electrode voltage.

In this set-up the leveler output adds directly to the voltage from the electrode power supply so that the minimum RF output will be determined by the electrode power supply setting. Neither square wave modulation nor RF level control can reduce RF output below value set by the electrode supply DC level. This arrangement therefore is best suited for CW leveling only.

3-9 INITIAL OPERATION

1. Before turning on Leveler power switch, set panel controls as follows:

OUTPUT switch on FLOATING or DIRECT as required.

SQUARE WAVE switch off.

TIME CONSTANT COARSE and FINE to MAX position.

Set ERROR BALANCE at about mid-position.

PHASE switch should be in "+" position if a positive going control signal is required to increase RF output. The "-" position gives a negative going voltage for increased RF level. See Paragraph 3-8 for phase required for various modes of operation.

CAUTION: Be sure PHASE is correct. If reversed, RF may be driven to full uncontrolled value.

RF DB switch at "0"

RF LEVEL control fully counterclockwise.

LEVEL CALIB. adjustment about 10° from fully counterclockwise.

2. Turn on power switch and allow 5 minutes warmup.
3. Also turn on associated RF equipment to standby condition and allow adequate warmup.
4. Depress PRESS TO BALANCE switch and adjust BALANCE control until meter pointer is on zero line (not 0 db). Release push button and needle should remain at zero line.
5. Connect an RF power indicator to RF output.
6. Turn on RF source. Slowly turn RF LEVEL and LEVEL CALIB. controls clockwise to raise power level and meter indication to desired value. On standard units 0 db level can normally be set for 1, 10, or 100 milliwatts. Panel meter reading and RF DB switch then indicate RF power level correctly at levels below 10 milliwatts. From 10 to 100 milliwatts due to crystal detector or non-linearity, meter indication must be corrected to obtain accurate power level measurement. Use Figure 2-2 to convert readings.

On 1 watt and 10 watt models, non-linear region requiring correction to meter readings occurs from .1 to 1 watt and 1 to 10 watt levels respectively. If an external crystal detector does not give square law operation, meter indication will be non-linear. Reducing R1 may improve linearity. Typically as low as 3.3 K has been required for some detector units.

7. Turn SQUARE WAVE switch ON. Rotate TIME CONSTANT COARSE switch counterclockwise and vary TIME CONSTANT FINE control over its range. Reduce time constant until meter reads 3 db below the former CW level. Further reduction of time constant usually will cause loop instability and oscillations as indicated by an abrupt increase in meter level.

Disconnect external power meter and, if possible, observe RF output using a crystal detector and oscilloscope. Adjust time constant controls for best square wave response. Also reduce RF LEVEL control noting duty cycle of square wave. If necessary, adjust ERROR BALANCE to maintain constant on to off ratio to as low an RF level as possible and still have no RF during off portion. That is, advance the control until a small CW RF level exists and then reduce the setting slightly. This adjustment is most accurately done with leveler RF DB switch on the -20 position.

Return RF DB switch to "0" position. For variable frequency uses (such as

with swept oscillators), scan frequency over its range and trim TIME CONSTANT FINE slightly if necessary to give stable operation over the band. Also, vary RF DB switch and fine TIME CONSTANT settings for best compromise of transient response at all levels. Disconnect external crystal detector and connect normal RF load.

8. Instrument is now ready for operation. SQUARE WAVE may be left ON or off. Every few hours turn off RF source, operate PRESS TO BALANCE switch, adjust BALANCE control for zero meter indication and release PRESS TO BALANCE switch.*
9. For short standby operation turn RF LEVEL control fully counterclockwise to reduce RF to zero. For longer standby conditions turn off controlled device. Resulting error at Leveler output normally cannot cause harm. However, if DIRECT output is connected to a grid, it may be desirable to use a small shunt diode to prevent positive error voltage being applied during standby condition. See Paragraph 3-8 for hook-up suggestions. OUTPUT switch may be set at FLOATING to remove this signal. When turning RF on, overshoot usually occurs before Leveler regains control.

3-10 REPEAT OPERATION

1. Turn on Leveler and associated equipments and allow five minutes warmup. RF source should be OFF. *
2. Operate PRESS TO BALANCE switch and zero meter with BALANCE control.
3. Turn on RF source and set RF LEVEL.
4. Turn SQUARE WAVE switch to ON if desired, and set frequency.
5. Reduce RF LEVEL or turn off RF source during standby.
6. Turn off RF source and check amplifier balance every 2 to 3 hours.

3-11 TYPICAL SET-UPS

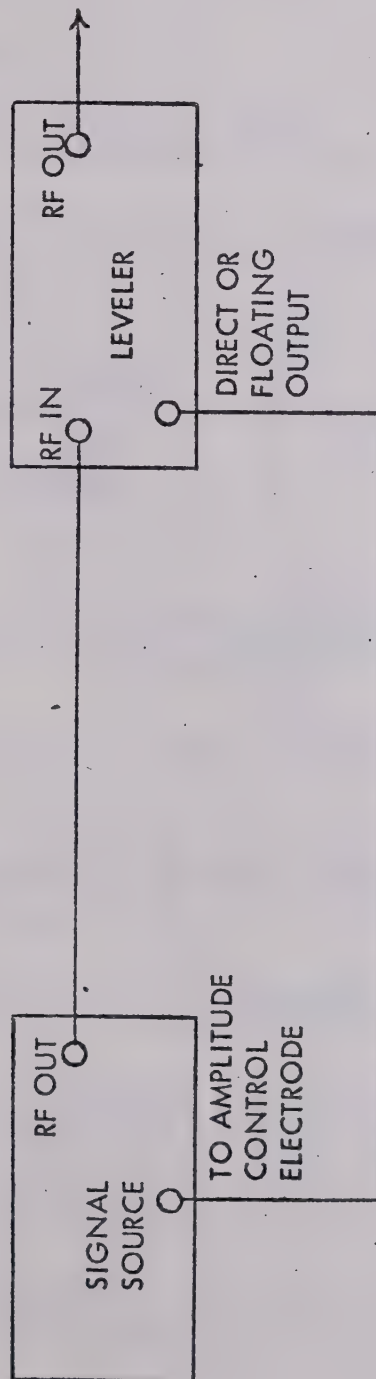
Figure 3-1 shows the general case of the leveler controlling the output of an RF device. Figure 3-2 shows a typical set-up where the leveler is controlling the output of a Microwave Amplifier for constant output to an RF device.

*Allow approximately one hour for instrument to reach final stability.

SECTION 4 - MAINTENANCE

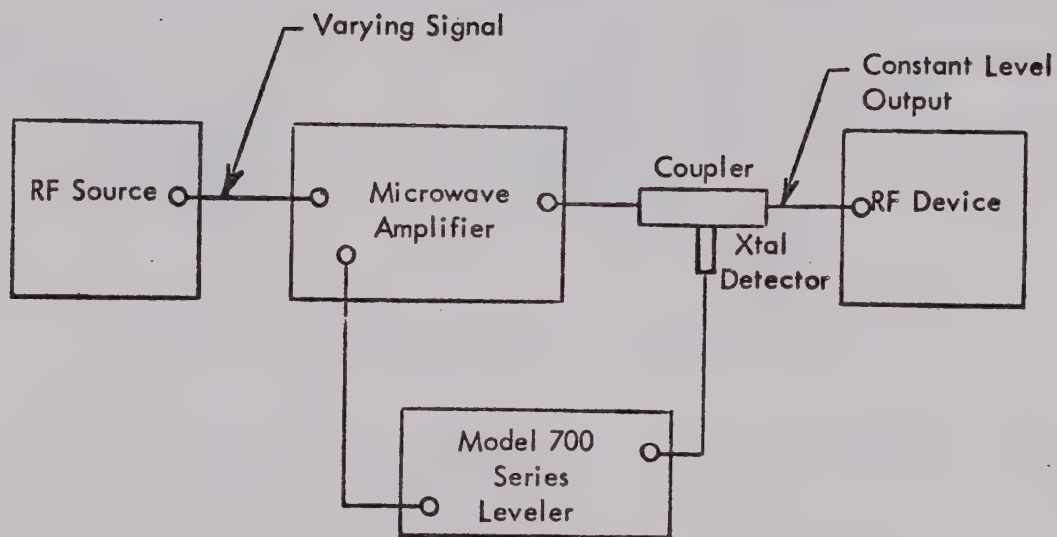
4-1 ROUTINE

Regular maintenance need only consist of periodically checking tubes to detect marg-



BAYTRON SYSTEMS
1720 Newport Circle
Santa Ana, Calif. 92705

Interconnecting Diagram
Figure 3-1



Typical set-up for maintaining constant signal to RF device

Figure 3-2

inal performance. Typically, tests should be made every 6 months when instrument is in frequent use. Reasonable care should be exercised in handling and transporting the equipment to prevent damage. Repairs should be undertaken only by qualified personnel and with sufficient and accurate test equipment. Carefully analyze difficulties before making an adjustment. An unnecessary adjustment or repair may impair the accuracy of the instrument.

4-2 TROUBLE SHOOTING

Should a failure occur, follow a logical procedure to locate the cause. Refer if necessary, to the Theory of Operation Section of this manual and the schematic diagram.

A blown fuse should be replaced with type 3 AG, of 3 ampere rating. By removing screws holding top dust cover and shoving it rearward, all tubes can be observed if heaters are operating and voltage regulator tubes lit. The heaters of V1, V2, V3, V4, V5, V7, V8, V13, V14 and V18 are connected in series with relay RY1 to the -150 volt supply. Should any heater burn out, all will be turned OFF and relay RY1 released, thereby disconnecting all positive voltages.

Test tubes. If tubes are satisfactory, remove bottom plate and check DC voltages using a high resistance voltmeter. Principal DC voltages are indicated on schematic diagram and Section 4-4. If voltages are incorrect, remove power plug and systematically make resistance checks. CAUTION: Dangerous high voltages are present in the instrument. Use care when checking or making repairs. Accidental shorts may cause component damage before the fuse blows. Be sure that at all times the chassis is grounded. See Figure 4-1 for Tube Location Chart.

Overall amplifier performance can be easily checked by using a square wave source with output adjustable from a few millivolts to one volt connected to amplifier input cable (normally attached to crystal detector). Waveform at output of pre-amplifier can be observed at Pin 2 of V6. Output of error amplifier can be observed at DIRECT receptacle with output switch in DIRECT position. RF LEVEL must be fully counterclockwise. Vary ERROR BALANCE control to zero error amplifier.

If V1 or V2 is replaced or if aging of these tubes produces any serious offset of the panel meter zero point, change the setting of OFFSET potentiometer R79 as follows.

After one hour warmup, set LEVEL CALIB. potentiometer counterclockwise and RF DB switch to zero. Push PRESS TO BALANCE button and adjust BALANCE control so that meter pointer is on scale near zero line. If not, adjust OFFSET potentiometer R79 until it does. Turn RF DB switch to -20 for increased sensitivity. Repeat until offset is zero when amplifier is properly balanced.

Chopper ordinarily should require no maintenance for several years. However, it may be opened for adjustment by unscrewing clamp ring around bottom of case. Contacts

may be cleaned by carefully drawing a thin sheet of paper between them. If adjustment is required, set contact closure for 55% of each cycle. Using a 1.5 volt battery and a 47 K resistor in series with contacts, observe voltage across contacts on an oscilloscope to indicate duty cycle.

4-3 WARRANTY

All workmanship and materials except crystal detector are guaranteed for one year. Crystal life is normally quite long, but because the crystal detector is fragile and can be damaged by overload, life is not warranted. Replacement crystal may be purchased from ALFRED ELECTRONICS or directly from the manufacturer of the detector assembly.

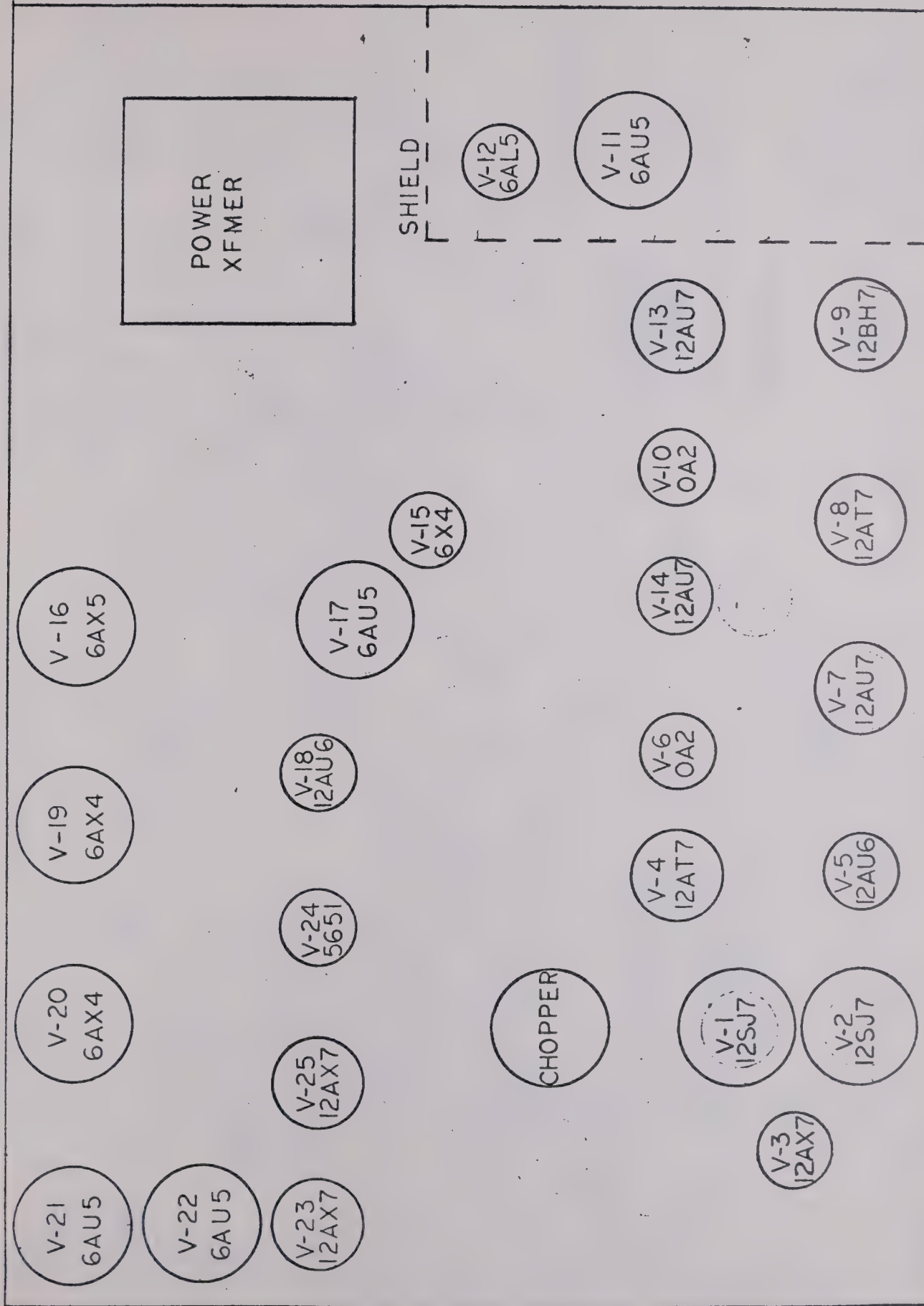
Details concerning warranty adjustments are presented on "Shipment Damage Claim" page at the end of this manual.

4-4 DC VOLTAGES

Typical voltage values relative to ground are listed below at the following conditions:

1. 20, 000 ohm/volt meter.
2. LEVEL CALIB. full clockwise.
3. RF LEVEL full counterclockwise
4. SQ WAVE off
5. OUTPUT on DIRECT
6. With no input and BALANCE set, output is adjusted to zero with ERROR BALANCE.

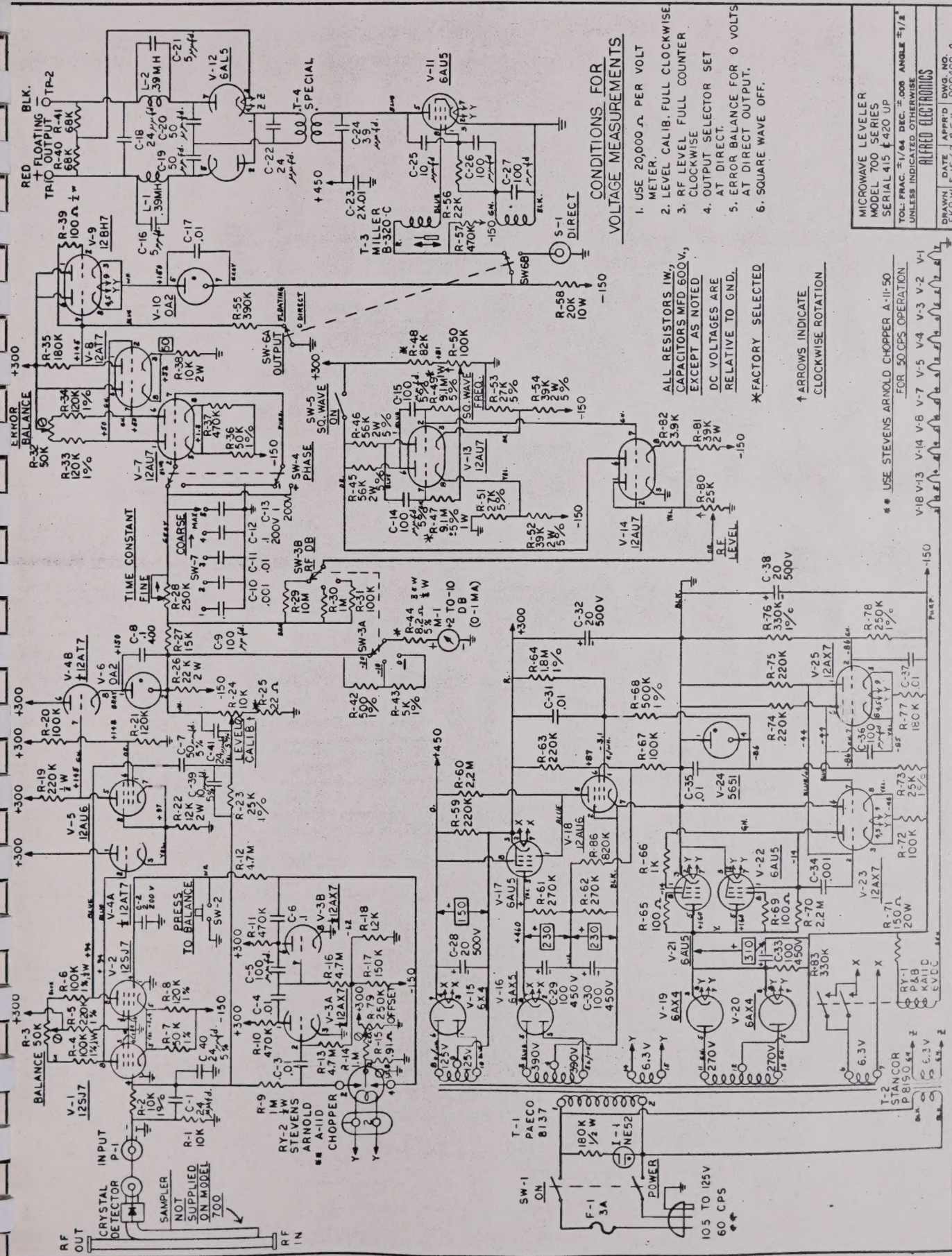
Item	Tube Type	Pin Number								
		1	2	3	4	5	6	7	8	9
V1	12SJ7		12.6DC 2-7	3.9	0	2.4	80		94	
V2	12SJ7		12.6DC 2-7	3.9	0	2.4	80		94	
V3	12AX7		0	0	12.6DC 4-5			0	0	
V4	12AT7	300	81	85	12.6DC 4-5		300	145	150	
V5	12AU6	81	85	12.6DC 3-4		145	143	97		
V6	OA2	150	0							
V7	12AU7	56	0	1.3	12.6DC 4-5		56	0	1.3	
V8	12AT7	144	56	59	12.6DC 4-5		300	56	59	
V9	12BH7	300	144	150	6.3AC 4,5-9		300	144	150	
V10	OA2					150		0		
V11	6AU5	0	6.3AC 2-7	0		450			0	
V12	6AL5	0	0	6.3AC 3-4		0		0		
V13	12AU7	0	-61	-61	12.6DC 4-5		0 -59	-60	-61	
V14	12AU7	-59	-59	0	12.6DC 4-5		0	-61	-59	
V15	6X4	300		6.3AC 3-4			300	450		
V16	6AX5		6.3AC 2-7	0		0			460	
V17	6AU5		6.3AC 2-7	300		460			450	
V18	12AU6	-3.1	0	12.6DC 3-4			87	0		
V19	6AX4			-310		-150		6.3AC 7-8		
V20	6AX4			-310		-150		6.3AC 7-8		
V21	6AU5	-14	6.3AC 2-7	0		160			160	
V22	6AU5	-14	6.3AC 2-7	0		160			160	
V23	12AX7	-14	-44	-46	6.3AC 4,5-9		0	-44	-46	
V24	5651	0			-86					
V25	12AX7	-44	-86	-85	6.3AC 4,5-9		-44	-86	-85	



MODEL 700
TUBE LOCATION

BOTTOM VIEW

ALFRED ELECTRONICS
7/19/60
900460 A



CONDITIONS FOR VOLTAGE MEASUREMENTS

1. USE 20,000 Ω PER VOLT METER.
2. LEVEL CALIB. FULL CLOCKWISE
3. RF LEVEL FULL COUNTER CLOCKWISE
4. OUTPUT SELECTOR SET AT DIRECT.
5. ERROR BALANCE FOR 0 VOLTS AT DIRECT OUTPUT.
6. SQUARE WAVE OFF.

ALL RESISTORS 1W.,
CAPACITORS MFD 500V.,
EXCEPT AS NOTED
DC VOLTAGES ARE
RELATIVE TO GND.

*FACTORY SELECTED

↑ ARROWS INDICATE
CLOCKWISE ROTATION

MICROWAVE LEVELER
MODEL 700 SERIES
SERIAL 415 #420 JP

◆◆◆ USE STEVENS ARNOLD CHOPPER A-11-50

FOR 50 CPS OPERATION

V-18 V-13 V-14 V-6 V-7 V-5 V-4 V-3 V-2 V-1

03/08/19 03:03:16

DRAWN SKB W	DATE 5-15-62	APPR'D R E H	DWG. NO. 900499 C
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